

ZERO WASTE CENTRE FEASIBILITY STUDY

FOR THE WAVENEY DISTRICT OF SUFFOLK COUNTY, UK

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I. ZERO WASTE CENTRE SUMMARY AND RECOMMENDATIONS

This feasibility study provides a description and conceptual design for a Zero Waste Centre (ZW Centre) in the Waveney District, with estimated costs, potentials for diverting resources from waste, and a summary of the Centre's opportunities and potential barriers.

These are keys to the project's success:

- ◆ To site the facility so it is convenient to the discarding public and is also located in an appropriately-zoned area in the community.
- ◆ To build into the design of the businesses and facilities the appropriate incentives and technologies that can cost-effectively use existing and developing markets and transportation systems.
- ◆ To incorporate three hierarchical priorities into the plans for both the businesses and the facilities: first to reduce discards, then to reuse and repair them, and finally to dismantle and recycle or compost them.

The conceptual design recommended for the Waveney District Zero Waste Centre (ZW Centre) builds upon existing public and private investments in the area. The ZW Centre will be most happily accepted when it complements and expands current capacity to handle discarded materials, and does not undermine any existing activities except wasting. Existing enterprises could participate at several levels of commitment. They could move their entire operations to the Centre, develop an expansion facility there, or provide staffed or unstaffed trailers or storage boxes at the Centre to receive materials that would be taken elsewhere for processing.

The ZW Centre will colocate receiving and processing for reuse, recycling, and composting with manufacturing and retail enterprises in a central facility where the public can take all their discarded and recoverable materials at one time. For-profit and not-for-profit enterprises might repair durable goods and will sell many kinds of reusable items to the public in retail or wholesale sales. Others will prepare feedstocks for manufacturers and produce saleable products to be marketed elsewhere. There will be many opportunities for internal trading between processors. Also, the Centre can be an incubator for businesses that manufacture products from the resources supplied by other businesses within the Centre. Service enterprises can help the community's resource-generating businesses eliminate wastes and devise appropriate end-of-life programs for their products and packaging, such as voluntary takeback systems.

The ZW Centre will provide Waveney the opportunity to implement reducing, reusing, repairing, recycling, and composting as priorities over wasting both in policy and in the built system. The more effectively residents and businesses are informed about how to use the new system, and the more convenient the resource system is, the less waste there will be for the waste management system to manage.

If all the people who live and work in Waveney participate, more than £2.07 million of new revenue from sales of products and materials can be generated, to recirculate in the community annually. In addition, at £49 per tonne, the community would save more than £3.44 million in costs for landfilling per year. That is, the community would be ahead by £5.51 in currency each year, having generated jobs and businesses in the bargain.

To accomplish this result, by laws, contracts, or policies, gate fees at Suffolk County's landfills and other facilities where discarded materials are stored, collected, and disposed of should be structured to encourage bringing materials that are separated. County landfills could offer either free recycling services before the landfill's entry gate, or fee discounts for materials that arrive clean and separated, and that are placed in designated containers.¹ Materials in these containers could be delivered to the ZW Centre for processing.

The ZW Centre general operator and its niche enterprises should pay for incoming materials or charge service fees as appropriate, depending on internal expense and investment structures. That is, the biggest factor determining whether and how much the operator will pay users or charge them is how expected income compares to expected outlays. If a given object or material will sell for *exactly* enough money to cover operating expenses, capital costs, and necessary profit or surplus for reinvestment, then the operator can accept the item for free. If expected income is higher than expenses and other outlays, the operator can pay for the item or use the extra proceeds to cover less-profitable parts of the operation. If expected income is less than expenses, the operator must charge a service fee to make ends meet. Paying or saving users even small amounts will change behavior faster than not paying or saving. Over time, payments and fees will be adjusted frequently to maintain a dynamic balance in the enterprise and enhance prospects for long-term survival and growth, thus encouraging both maximum entrepreneurial zeal and maximum community participation. The decision structure looks like this:

¹A precedent for this pricing is that yard trimmings are not now charged the national landfill tax, making it much less expensive to dispose of them as source-separated materials than as solid waste.

<p>IF</p> <p>Income</p> <ul style="list-style-type: none"> - Operating expenses - Profit or investment surplus, including <u>amortized capital costs</u> <p>= Positive number</p>	<p>IF</p> <p>Income</p> <ul style="list-style-type: none"> - Operating expenses - Profit or investment surplus, including <u>amortized capital costs</u> <p>= 0</p>	<p>IF</p> <p>Income</p> <ul style="list-style-type: none"> - Operating expenses - Profit or investment surplus, including <u>amortized capital costs</u> <p>= Negative number</p>
<p>THEN</p> <p>PAY USER (maximizes behavior change and good word-of-mouth community education)</p> <p>OR use surplus to support processing for less-profitable materials.</p>	<p>THEN</p> <p>ACCEPT FREE</p> <p>OR charge small user fee less than landfilling to support service for other less-profitable materials.</p>	<p>THEN</p> <p>CHARGE SERVICE FEE, less than landfilling.</p>

Using these internal financial cues to price handling and processing services will increase the likelihood of an enterprise's success while still providing the community the full benefits of avoiding landfill costs and pollution.

In all cases the ZW operator should be able to charge users a lower service fee than transfer stations or landfills, which make no salable products and should be required to cover both long-term liabilities and short-term costs with service fees alone (without funding from general taxes). If properly structured, the developer of the ZW Centre is in a unique position to leverage private investment by shifting avoided costs, if these service-price signals are right.

The conveniently-located Waveney ZW Centre is designed to handle approximately 300 tonnes of discarded materials per day. Most of the customers that will be attracted to it will be vehicles driven by landscapers, construction crews, householders (including tenants), commercial businesses, and small private haulers. When they carry their own materials, they are "self-haul" users. Generally their loads will be composed of only a few categories of materials, most of which will be reusable or recyclable within the site.

Over time, self-haulers will learn to take full advantage of opportunities to avoid wasting by stratifying their loads for sequential drop-off. Frequent users most concerned with the financial advantage will learn fastest. The materials-handling sequence will be: to prevent discarding in the first place with revised consumption patterns and other preventive measures; then to use the ZW Centre to drop off materials free for reuse, then free for recycling; and finally to go to the fee-for-service recycling and composting areas. Users who go to the fee-for-service enterprises will pass through fee gates, which are income portals from the operators' perspective. An option that would increase customer convenience would be to locate a skip at the ZW Centre after reuse and recycling services so customers could deposit any materials to be transferred to landfill, as the current HWRC and Bring stations provide. Using these boxes could

either be less expensive than or cost the same as the waste tipping fee but be more convenient.

The Centre's financial position looks sturdy. Total capital and equipment costs are estimated to be about £7.1 million, not including land. It is assumed that the land will either be donated or acquired with grant funding. Annual operating and maintenance costs, including amortized capital and equipment costs, are estimated to be about £1.3 million per year. The Reuse area may yield net income up to £141 per tonne; the Recycling area shows a £31 per tonne savings over landfill; the Regulated Materials area will save £41 per tonne; the Organics area will save £56 per tonne; and the C&D area will save £51 per tonne. In each case, recovering a tonne saves £49 in landfill costs. The overall benefit per ton for the ZW Centre is £52 per tonne, including the more than £3.4 million savings from avoiding landfilling expenses.

Based on these financial results and a practical design, the Waveney ZW Centre looks highly promising for waste reduction and community wealth development.

II. ZERO WASTE CENTRE FEASIBILITY STUDY

The Waveney District is located in the easternmost portion of Suffolk County. In the county's second-largest city, Lowestoft, the District would like to introduce sustainable resource-management practices to stimulate local and regional economic growth.

A. STUDY GOALS AND OBJECTIVES

This study provides a description, conceptual design, estimated cost, and potential diversion from waste expected for a Zero Waste Centre (ZW Centre) in Waveney, with a summary of opportunities and potential barriers to its establishment. The study's goal is to determine the revenues and costs and make recommendations for permitting, building, and operating a successful ZW Centre that will divert discarded materials away from wasting.

These are the keys to the project's success:

- To site the facility so it is convenient to the discarding public and is also located in an appropriately-zoned area in the community.
- To build into the design of the businesses and facilities the appropriate incentives and technologies that can cost-effectively use existing and developing markets and transportation systems.
- To incorporate three hierarchical priorities into the plans for both the businesses and the facilities: first to reduce discards, then to reuse and repair them, and finally to dismantle and recycle or compost them.

A note on terminology. *Since the goal of this project is to help the Waveney District achieve Zero Waste, terminology in this report abandons the assumption that any discarded object can be defined automatically as waste. The goal of the ZW Centre is to prevent wasting by receiving discarded resources and returning them to economic use. Therefore this document refers to incoming materials as "discards," "resources," "supplies," or "materials flows," and not "wastes." "Wastes" are materials that are wasted. (Waste isn't waste until it is wasted.)*

Similarly, customers who bring resources to the Centre are "users," "generators," or "suppliers." Customers who purchase products are "buyers." This structure of thinking is simple but is different from wasting systems at its conceptual foundation, so it generates strikingly different financial structures and different decision-making criteria as it is elaborated through the system. Becoming accustomed to it takes awhile, and effort is rewarded with spontaneous flashes of insight.

B. CURRENT SYSTEM AND PROJECTIONS

Suffolk County's residential waste system is self-contained. Virtually all unrecycled resources that arise from the county's residents are landfilled within county borders,

with little exported or imported. The county has no incinerators, and gas projects at the landfills recover energy. From 1995 to 2000 the amount of resources going to landfill grew, but in 2000 recycling and composting rates also increased.

The county has four landfills that accept unrecycled resources; local Waste Collection Authorities deliver their materials to the closest one. Waveney delivers to the Wangford Landfill Facility. At current levels of flow, permitted landfill sites have sufficient capacity to last through 2015. Increased waste prevention, including expanded reuse, recycling, and composting, can extend these landfills' lifespans.

In 1998 a decision was made to prepare a Municipal Waste Management Strategy for the County, and Local Authorities have been preparing plans since then. They are committed to cooperative planning and implementation, and their plans conform to the National Waste Strategy. The Suffolk County BPEO Analysis incorporates recycling and composting plans for each Waste Collection Authority, and all Local Authorities have ratified it.

In Waveney, the primary methods of household resource collection and management are:

- ◆ Weekly wheeled-bin waste collection.
- ◆ Kerbside recycling – 99.8% of households have service.
- ◆ Bring sites, which accounted for 5.2% of recycling in 2001-02.
- ◆ Composting for yard trimmings, which are collected on a fortnightly basis in a green bin. Putrescibles are currently landfilled.

The following materials are currently collected in the 3-bin system from households:

Table 1 – Kerbside Recycling System in Waveney

Week 1		Week 2
BLACK BIN UNRECYCLED MATERIALS	GREEN BIN PLANT TRIMMINGS	BLUE BIN DRY RECYCLABLES
Ash Bones - chicken, beef, fish, lamb Bread, biscuits, & crisps Broken glass Broken kitchen utensils Cooked food Cosmetics Dairy products Disposable nappies Feathers Kitchen scraps Nail varnish Old light bulbs Pet droppings Porcelain & ceramics Processed food Soiled kitchen roll Soiled tissues Tea bags Vacuum cleaner contents	Christmas trees (real) Dead flowers Windfall fruit Grass cuttings Hedge prunings Leaves and bark Plants (including roots) Salad trimmings Tree bark Tree cuttings Weeds	Aluminum foil Cans, aluminum & steel Catalogues & brochures Cardboard boxes Cereal boxes Christmas wrapping Egg boxes Envelopes Fruit drink cartons Greeting cards Junk mail Magazines Milk cartons Newspapers Paper Phone Directories/ Yellow Pages Plastic bottles Plastic milk cartons Pots & pans Steel bits (screws, paper clips, bent brackets) Tissue paper Tubs Washing powder boxes

Local Bring sites also allow for the disposal of glass; paper; textiles and cans.

Other non-hazardous materials can also be taken to the Household Waste and Recycling Centre (HWRC) at Wildes Street, off Whapload Road, Lowestoft. This HWRC is scheduled to move in 2006 to Hadenham Road near one of the proposed sites for the ZW Centre. It accepts materials that include:

- Scrap metal
- Glass bottles and jars
- Textiles
- Engine oil
- Refrigerators
- Car batteries
- Mobile phones

Suffolk County contains many service providers in waste disposal, recycling and composting, some of which currently operate within Waveney, including the following.

Commercial Waste Disposal and Transfer Firms include:

- ◆ Hales C R, W A S Ltd.
Waveney Contract Services
- ◆ Greenways Waste Mgt.
- ◆ Asco PLC
- ◆ W T Transport
- ◆ Biffa Waste Services
- ◆ Mallory Environmental Services
- ◆ Viridor Waste
- ◆ Culford Waste Services Ltd.
- ◆ Enviro-Waste Ltd.
- ◆ S Sacker Ltd.
- ◆ Marcis Waste
- ◆ Wastecare

Recycling Companies include:

- ◆ Seago & Harrison (Lowestoft) Ltd.
- ◆ S C A Recycling, Ltd.
- ◆ C & L Waste Oil Collection
- ◆ Stowmarket Resource Centre
- ◆ Sudbury Resource Centre
- ◆ Suffolk Scrap Store
- ◆ Anglia Recycling
- ◆ Bolton Bros.
- ◆ Fibropower
- ◆ J E Clark
- ◆ Viridor Waste Management
- ◆ Wastesaver (Ipswich Borough Council)
- ◆ Ipswich Furniture Project
- ◆ Waste Recycling Group
- ◆ Balcan Engineering Ltd.
- ◆ Recycleite Ltd.
- ◆ OFTec Ltd.
- ◆ Takeback
- ◆ International Recycling
- ◆ Chase Plastics Ltd.
- ◆ Globalmark UK
- ◆ Marchant Manufacturing Company Ltd.
- ◆ Save-a-Cup Recycling Company Ltd.
- ◆ Envirocare

Mobile Phone Recycling Companies include:

- ◆ Stowmarket Resource Centre
- ◆ Sudbury Resource Centre
- ◆ Roundwood/Shire Hall
- ◆ Action Aid Recycling
- ◆ Cellular Reclamation, Ltd.
- ◆ OFTec Ltd.
- ◆ Suffolk Scrap Store

Skip Hire Companies include:

- ◆ B & B Skip Hire
- ◆ Lowestoft Skip-Away
- ◆ Waters P W Ltd.

Composting Companies include:

- ◆ Alpeco Ltd.
- ◆ Biffa
- ◆ County Mulch Ltd.

In 2004-05, the Waveney District was projected to generate 55,730 tonnes of unrecycled resources and to recycle 14,962 tonnes of materials – a recycling rate of about 27%.² In 2006-07, current projections foresee Waveney generating 59,111 tonnes of unrecycled resources and, with currently planned expansion of recycling programs, recycling 21,666 tonnes – a 37% recycling rate.

These estimates place the Waveney District on a par with the estimated 38% recycling rate for all of Suffolk County's Districts in 2006-07. The county as a whole is estimated to generate 413,236 tonnes of unrecycled resources in 2006-07, and to recycle an estimated 158,736 tonnes. Unrecycled industrial and commercial resources in the county account for 60% of the supply stream.

In May 2005, Suffolk Local Authorities issued a report estimating that recycling and composting rates could reach as high as 60%.³

In the last ten years, although both wasting and recycling in Suffolk County have grown, the recycling rate has more than doubled.

	Arisings Wasted	Recycled	Recycling Rate
1995-96	300,000 tonnes (approx)	23,000 tonnes	8%
2001-02	382,000	71,000	19%

Between 1995 and 2002, wasted arisings grew at an average rate of 4.3% per year. In the past two years indications are that the rate of increase may be slowing, although there have been no decreases yet. This result underscores how important it is that Zero Waste programs eliminate wasting by working to reduce consumption as well as to reuse, recycle, or compost all parts of the discard stream.

Many local and regional entities internationally have established goals to achieve Zero Waste. In the US, some communities have recently adopted Zero Waste goals, including: San Francisco, CA; Seattle, WA; San Luis Obispo County, CA; Del Norte County, CA; Santa Cruz County, CA; City of Palo Alto, CA; City of Berkeley, CA; City of Burbank, CA; and the Central Vermont Solid Waste Management District. The State of California also has adopted Zero Waste as a goal.⁴ In the US, cities and counties that have adopted short-term goals to reduce, reuse, recycle, or compost 75% of their currently unrecycled resources include Los Angeles, San Francisco and Alameda County (Oakland area), CA. Seattle, WA, is about to adopt a 60% short-term target. Note that these goals do not include credit for any form of waste incineration. (The California goals, however, count a landfill's "alternative daily cover" – often shredded plant debris – toward recycling.) Many communities around the world have also adopted Zero Waste goals, including: over half of the Councils in New Zealand; Canberra, Australia; Halifax, Nova Scotia; Toronto, Canada; and Candon City,

² Source: "Municipal Waste Management Strategy for Suffolk – Adopted Version," Appendix 1.

³ Enviro, "Best Practicable Environmental Options Analysis and Sustainability Review of The Suffolk Joint Municipal Waste Strategy Framework Document," Mid-Suffolk District Council, Suffolk, 2005.

⁴ Adopted in 2001 in the CIWMB Strategic Plan, see: <http://www.zerowaste.ca.gov/Commitment.htm>

Philippines. Many businesses are moving toward Zero Waste, reducing their wasting by over 90%, including large and small companies such as Xerox, Fetzer Vineyards, Hewlett-Packard (Roseville, CA), Pillsbury, Mad River Brewing Company, and many restaurants in San Francisco, CA, particularly those that participate in the City's new discarded food composting program.

C. REGULATORY ENVIRONMENT, DIRECTIVES, AND PLANS

The Waveney District is subject to rules and regulations promulgated by both the European Union (EU) and the UK National Government. Responsibility for implementation lies with the local governments of Suffolk County and Waveney.

The EU Waste Framework is a directive that provides the overarching framework for collection, transport, recovery and disposal of wastes. Member States of the EU are required to take the necessary steps to ensure that waste is recovered or landfilled without danger to public or environmental health. Reduction and reuse are emphasized as strategic approaches. Complementary Directives include: WEEE and ROHS Directives; Waste Oil Directive; Hazardous Waste Directive; Packaging, the Packaging Waste Regulations; Landfill Directive; End-Of-Life Vehicle Directive; Batteries Directive; Biowaste Directive; Waste Incineration Directive; Environmental Protection Act, 1990; Environmental Act, 1995; Information on the Waste and Emissions Trading Act, 2003; The Producer Responsibility Obligations Regulation, 1997; The Finance and Landfill Tax Regulation, 1996; and the Waste Minimisation Act, 1998.

The UK has passed parallel legislation to the EU Directives and Regulations. These include: the Waste Strategy for England, 2000; Waste Not Want Not Cabinet Office's Strategy Unit Review, 2002; Waste Strategy Review, 2005; Review of Environmental Health Effects of Waste Management, 2004; UK Government Response to the European Commission's Communication, "Towards a Thematic Strategy on the Prevention and Recycling of Waste"; and the Waste and Resources Action Programme (WRAP) of developing markets for recycled materials.

The following objectives have been articulated in the national strategy and the EU Landfill Directive:

- ◆ By 2010, reduce biodegradable resources going to landfill to 75% of 1995's generation values.
- ◆ By 2013, reduce biodegradable resources going to landfill to 50% of 1995's generation values.
- ◆ By 2020, reduce biodegradable waste going to landfill to 35% of 1995's generation values.

These are key elements of the program to achieve these diversion rates:

- ◆ Working partnerships, community involvement, and education.
- ◆ Waste reduction and reuse.
- ◆ Multiple kinds of collection and processing for recycling and composting – kerbside collection, home and community-based composting, Bring sites, household amenity centres.

At the local level, government is responsible for providing services. In Waveney, there is a two-tier authority for solid waste management. Lowestoft is within the Waveney District in Suffolk County. The District and the County have created the Waste Local Plan that is a statutory plan that addresses the land-use aspects of waste management. The Suffolk County Council is the local waste planning authority. The Waveney District has prepared its own Waste Strategy.

Local Authorities have responsibility for identifying land that may be suitable for waste management facilities, and deciding on planning applications for proposed waste management activities.

D. COMMODITIES AVAILABLE FOR DEVELOPMENT

One key to achieving Zero Waste is to persuade or require materials suppliers to separate their discards before they arrive at the Zero Waste Centre. According to analyses by Urban Ore of Berkeley, California, all discarded materials can be classified into 12 master recoverable categories, the “Clean DozenSM.”⁵ One category, reusable goods, is composed of objects that would fall into one of the other resource categories for reprocessing, but instead they can be returned to commerce in their already-manufactured form, with or without repair.

**Table 2 - Clean DozenSM
Resource Categories**

- | | |
|-------------------|------------|
| ◆ Reusables | ◆ Paper |
| ◆ Textiles | ◆ Metals |
| ◆ Plant trimmings | ◆ Glass |
| ◆ Putrescibles | ◆ Polymers |
| ◆ Ceramics | ◆ Wood |
| ◆ Chemicals | ◆ Soils |

⁵ The term “Clean Dozen” is a service mark of Urban Ore, Berkeley, California. It refers to this list of master categories of resources. Everyone is welcome to use the term provided credit is given.

Discards generated (arising) in the Waveney District of Suffolk County are estimated at approximately 164,000 tonnes per year in 2006 for the 114,000 people, based on the analysis in Table 3 below. This table assumes equal amounts of resources from trade sources and households. Unfortunately trade data are not available, and acquiring them will require research. Suffolk Connect will undertake further work to obtain more information on the generation rate and sources of materials for this facility.

For purposes of this Feasibility Study, RAA has taken a conservative approach and has designed a facility to process fewer resources than the total potentially available, rather than designing a facility too large. When success requires more capacity, the Centre's throughput can be increased by adding staff, hours, or shifts to particular areas of the Centre that are most used to accommodate the flow. Based on the current total of 133,617 tonnes per year collected for landfilling, RAA estimates that 75%, or 100,000 tonnes per year, would be attracted to the Zero Waste Centre. These tonnes would comprise most of the resources from trades and some from households, particularly reusable goods and recyclables not included in the kerbside program.

Table 3 – Waveney’s Resources by Source

Resources by source⁶	Tonnes per Year
Household - recycled resources	
Total household recyclables, WCA ⁷	21,666
Total household recyclables, WDA ³	8,465
Subtotal - household materials recycled, WCA and WDA	30,131
Household - unrecycled resources collected	
Resources collected at kerbside, WCA	56,651
Resources collected at Bring sites, WCA	2,460
Subtotal - unrecycled household resources collected by WCA	59,111
Household - unrecycled resources self-hauled to HWRCs (WDA)³	15,392
Trade - unrecycled resources	
Trade resources collected by WDC ⁸	2,463
Trade resources collected by others ⁹	56,651
Subtotal - unrecycled trade resources	59,114
Analysis	
Unrecycled trade resources + household self-haul	74,506
Household arisings (wasted + recycled)	104,634
Unrecycled resources collected by WCA and WDA	74,503
TOTAL resource arisings in Waveney, household & trade	163,748
TOTAL unrecycled resources in Waveney, household & trade	133,617

The 100,000 tonnes used as a design estimate for this study are separated into the “Clean DozenSM” categories in Table 4 below.

⁶ Source of data: *Joint Municipal Waste Mgt. Strategy for Suffolk*, “Summary of the Strategy for Waveney District, March 2003.”

⁷ WCA = Waste Collection Authority. WDA = Waste Disposal Authority. Include materials collected from fly tipping, beach cleansing, and litter cleanups. HWRC = Household Waste + Recycling Centres.

⁸ On page 10 of Suffolk Strategy, “an estimated 2,125 tonnes of trade waste is collected by WDC (in 01/02).” Extrapolated that by 3% per year (as was done for total waste projections in chart on page 13).

⁹ Estimate: = Household Waste collected.

Table 4 - Amounts of Resources Available by Type¹⁰

Clean DozenSM Master Categories	Tonnes per Day¹¹	Tonnes per Year	%
1. Reusable goods	17	6,000	6
2. Paper	55	20,000	20
3. Plant Trimmings	19	12,000	12
4. Putrescibles	69	20,000	20
5. Wood	14	5,000	5
6. Ceramics	16	6,000	6
7. Soils	3	1,000	1
8. Metals	24	9,000	9
9. Glass	11	4,000	4
10. Polymers	27	10,000	10
11. Textiles	8	3,000	3
12. Chemicals	11	4,000	4
Total	274	100,000	100

People preparing to recycle sort their discards into materials groups for storage and transport. They take reusable goods and chemicals to dropoff locations, and paper, metals, and containers to buyback or dropoff locations, or they hold these materials to be collected for processing in Materials Recovery Facilities (MRFs). They compost organics on the property or hold them to be collected for centralized processing.

The Zero Waste Centre is also organized into operating clusters based on a balance of factors including user convenience, recovery hierarchy, similarity of processing, efficiencies in sharing equipment, traffic, and other interactions onsite. The optimal operating clusters that would provide maximum recovery for Waveney are Reuse and Repair; Recycling; Regulated Materials including chemicals; Organics; and Construction and Deconstruction. Operational details will be discussed later in this document. Here the focus is on profiling the commodities in the clusters.

¹⁰ Source: *Municipal Waste Management Strategy for Suffolk – Adopted Version*, Appendix 1.

¹¹ 365 days per year.

Table 5 - Distribution of Materials in the Processing Clusters

Clean DozenSM Master Categories	Tonnes per Year	Processing Cluster (Depending on load)				
		Reuse & Repair	Recycling	Regulated Materials	Organics	Construction & Deconstruction
1. Reusable goods	6,000	X		X		
2. Paper	20,000	X	X		X	
3. Plant Trimmings	12,000	X			X	
4. Putrescibles	20,000	X			X	
5. Wood	5,000	X			X	X
6. Ceramics	6,000	X				X
7. Soils	1,000	X			X	X
8. Metals	9,000	X	X	X		X
9. Glass	4,000	X	X			X
10. Polymers	10,000	X	X	X		X
11. Textiles	3,000	X	X		X	X
12. Chemicals	4,000	X		X		
Total	100,000					

It will be most useful to direct suppliers to processing clusters first by load type, then by materials categories. They will already have been sorted by vehicle type, because large commercial vehicles with multiple axles will use a different entry road from the general public, as described later in the site tour. Processing clusters will receive an overlapping range of resources depending on load types. For example, all clusters except one can expect to receive metals. Metal objects going to the Reuse cluster might be sinks, bathtubs, or chairs; metals going to the Recycling cluster might be cans or bent chairs; metals going to the Regulated Materials cluster might arrive as part of a refrigerator that needs its fluorocarbons removed before being recycled; and metals going to the Construction and Deconstruction cluster might be pipe, fencing, or rebar. Some of the business interactions onsite will be niche operators trading resources that arrive at neighboring clusters. The following discussion expands these ideas. Detailed analysis will depend on final site design, analysis of site operations, and business profiles of the operators. Operators will rebalance their interactions as market conditions change.

1. Reuse and Repair Cluster

This cluster features enterprises that reuse, repair, dismantle, remanufacture, and resell furniture, small and large appliances, electronics, textiles, toys, tools, plumbing fixtures, lighting, lumber, and other used building materials, household goods, and commercial

fixtures. The supply of reusable goods will come not only from site users, but also from all other processing clusters, because any category of recyclable resources might contain still-useful objects.

2. Recycling Cluster

This cluster principally receives separated household recyclables including paper, plastic, glass and nonferrous as well as ferrous (steel) metal containers, and larger pieces of scrap metals. The final design might specify that recyclable metals received elsewhere would be baled here for marketing. In that case, metals processed for market in this cluster might also include white goods (e.g. large appliances such as washing machines and refrigerators after chlorofluorocarbons are removed); small appliances; industrial or construction scrap (e.g. steel beams); dismantled structures; pipe; fencing; and metal sinks and bath tubs. Dismantling enterprises located here or in the service-fee area can separate couches and mattresses into several commodities including textiles for recycling, wood frames, polymer foam, and steel springs and frames. Once separated into scrap categories, these materials are recyclable. Master categories such as papers and metals can be subdivided into many smaller categories according to markets' needs. Nonferrous metals, for example, can be divided into at least 30 categories. Detailed market and operations analysis will determine how to optimize income and expenses by upgrading resources to meet buyers' specifications.

3. Regulated Materials Cluster, Including Chemicals

This cluster includes used motor oil, paint, pesticides, cleaners, and other chemicals from residents and small businesses. Batteries, refrigeration equipment, tyres, and appliances may also be handled here. A Zero Waste system will include programs to divert these materials from land disposal. One major feature of this cluster is that the enterprises will likely charge service fees. For example, a chemical recycler, a dismantler, or a reputable tyre collector may need to charge service fees.

4. Organics Cluster

This cluster's main processing methods are shredding and composting, so it can receive food, yard trimmings from gardens, vegetable trimmings from kitchens, other putrescibles, food paper, and un reusable wood. After more or fewer processing steps (depending on the outcome desired for a given batch), these materials can be blended into a range of valuable mulches and soil amendments. Even small pieces of intact wood can be sent to the reuse area for construction or for creative projects such as children's toys. Un reusable untreated wood kept in the cluster can be shredded for fuel. Wood injected with preservatives such as copper compounds cannot be recycled and should be reused with caution. Painted wood can be reused in applications where the wood will be painted again but cannot be recycled safely because of toxic compounds in the paint. To increase the range of product recipes, the composter can acquire resources from other clusters, for example drawing gypsum from sheetrock and drywall that arrives at the Construction and Deconstruction cluster. The tonnage of compost produced is always substantially smaller than the incoming tonnage of feedstocks because of changes during composting, especially water evaporation.

5. Construction and Deconstruction Cluster

This cluster's processes use big crushing machinery and other large, high-capital cost equipment, in addition to hand separation. The resources it receives include ceramics such as rock, soils, concrete, asphalt, and brick, as well as land-clearing debris and mixed construction and deconstruction materials, including wood. For information on wood, see the Organics Cluster discussion above. Special projects such as home or commercial construction and deconstruction happen periodically and can bring in substantial tonnages all at once. Many loads of these materials will contain reusable building materials as well as resources that other operators will want for feedstocks.

E. SERVICES NEEDED

This analysis of service needs identifies areas that would benefit by expanding existing services or by eliminating materials now wasted. Service needs are profiled by types of items discarded. The "Programs" column identifies current services provided by public agencies, businesses, or Bring centers. The "Facilities" column shows whether services are currently provided in Suffolk County ("In") or elsewhere in the UK ("Out").

Table Key **Programs**

Agency = A
Business = B
Personal = C

Facilities

In Suffolk = In
In UK = Out

1. Resources and Their Current Services

Table 6 - Waveney Service Needs Analysis

Item	Programs	Facilities	Current services, with needs
1. Reusables			
Appliances - large	B, A	In	Small businesses resell secondhand furniture and white goods (large appliances). Charitable agencies collect white goods from households and local authorities for reuse. The contract (up to 2007) for the removal of appliances from household waste and recycling sites is for reprocessing with NO reuse. Bulky goods collections (including furniture) from the kerbside (currently by WDC) goes to landfill.
Appliances - small	B	In	Triac Services (WEEE compliant), Lowestoft. Small business resale.
Durable plastic items	A	In	Charity shops.
Textiles	A, B	In	Charity shops, household waste and recycling centres, Bring banks, some occasional kerbside collections. Seuk (Stowmarket).
Mattresses & furniture	A, B	In (f) Out (m)	Charities, small businesses for resale. Local Authority bulky goods. Mattresses – Doncaster.
Composite construction & deconstruction	B	In	Aggregate companies, some aggregate reused on site. Skip companies that sort before landfill, including Woodies, Hales.
Books and catalogues	A, B	In	Charity shops, secondhand book shops, some social services scrap stores.
Other reusables		Out	

Item	Programs	Facilities	Current services, with needs
2. Paper	B	In	Sca Recycling (Lowestoft) collects from businesses.
Cardboard	A, B	In	A12 industries (Suffolk Social Services), Sca Recycling.
White ledger	B	In	Sca Recycling, Boultons, Pearsons.
Newsprint	B	In	Sca Recycling.
Magazines & catalogs	B	In	Sca Recycling.
Other office paper	B	In	
Paperboard	B	In	Sca Recycling.
Other / composite paper			
3. Plant trimmings			
Leaves & Grass	A		Waveney District Council, Shaw Trust – from kerbside, Centres & landscaping.
Prunings	A		Waveney District Council, Shaw Trust.
Branches & stumps	A		Waveney District Council, Shaw Trust.
4. Putrescibles			
Food scraps			Not separately collected from households.
Fish and meat scraps			Not separately collected from households.
Sewage sludge	B	In	Anglian Water.
Disposable diapers, feminine hygiene articles			Not identified. Polymers are a small component that can be screened out after processing. The fiber is usually cotton or polyester.
5. Wood			
Untreated wood	A, B	In	S.O.L.D. (charity), businesses that recover construction & deconstruction (C&D) materials.
Treated wood	A, B	In	S.O.L.D. (charity), businesses that recover C&D materials.
6. Ceramics			
Concrete	B	In	Apex building supplies (Ipswich), Abbots (Bury St Edmunds), Crusher Trucks (Stowmarket), Tarmac Recycling (Bury St Edmunds).
Asphalt paving	B	In	Tarmac Recycling (Bury St Edmunds).
Asphalt roofing			Not identified. Some asphalt mixes might be able to accept some.
7. Soils			
Gypsum board			Not identified.
Fines	B	In	Tarmac Recycling.
Topsoil			

8. Metals			
Auto bodies	B	In	Hales.
Aluminum cans	A,B, C	In	Charities, social services, local authority, bring banks, individuals (weigh in at supermarket on a monthly basis).
Steel cans	A, B,	In	
Ferrous metals	B	In	
Nonferrous	B	In	
Item	Programs	Facilities	Current services, with needs
9. Glass			
Clear glass containers	B	In	Bring banks (bottles and jars).
Mixed glass containers	B	In	Bring banks (bottles and jars).
Green glass	B	In	
Mixed glass	B	In	Household waste & recycling centres (also bottles and jars).
Brown glass	B	In	
Window glass			Not identified.
Other glass			Not identified.
10. Polymers			
# 1 PET	B	In	Chase Plastics (aka Breckland Plastics) – offer collection of baled plastics. Marchant Manufacturing Haverhill (outside collection radius). Pearsons, Thetford.
#2 HDPE Colored	B	In	
#2 HDPE Natural	B	In	
#4 Plastic bags	B	In	Collection points at supermarkets.
Film plastics	B	In	
Other plastics			
Tyres	B	In	Resite (new company in Beccles).
11. Textiles			
Poly fibres	A, B	In	Bring banks.
Cotton and wool	A, B	In	Bring banks.
12. Chemicals			
Used motor oil	A, B	In	Household waste & recycling centres.
Household hazardous wastes	A,B	In	Collected by Local Authority & stored at Great Blakenham MRF for disposal at authorized landfill. There is no Re Paint scheme *see attached brief.
Treated medical discards			Mostly incinerated locally. There are viable alternatives to incineration that are safer, cleaner, do not produce dioxin, and are just as effective at disinfecting pathological and chemotherapy medical discards. ¹²

¹² See *Non-Incineration Medical Waste Treatment Technologies*, an August 2001 report from Health Care Without Harm at: <http://www.noharm.org/nonincineration>.

2. Service Opportunities

Based on this review of available resources and current services, these resources stand out as priorities for development:

- ◆ Discarded food and food-soiled paper.
- ◆ Reusable goods, including appliances, building materials, home furnishings, art and collectibles. .
- ◆ Construction and deconstruction, particularly gypsum wallboard, untreated wood, metals, ceramics, soils, and asphalt roofing.

Each of these categories is likely to arrive in significant quantities in the unrecycled resource stream yet could be reused, recycled, or composted in appropriate facilities.

In addition, services for the following materials could be increased, or policies and disincentives could be developed to discourage their continued use in products:

- ◆ Glass – windows, “other,” and broken.
- ◆ Old light bulbs.
- ◆ Porcelain and ceramics.
- ◆ Cosmetics.
- ◆ Disposable nappies and feminine hygiene products.
- ◆ Treated medical materials.
- ◆ Ash.
- ◆ Feathers.
- ◆ Nail Varnish.
- ◆ Pet leavings.
- ◆ Vacuum cleaner contents.
- ◆ Oil filters.
- ◆ Rechargeable batteries.

Increasing services or developing new ones will provide opportunities for new enterprises operated by private companies, local government, or social enterprises.

3. Regulatory Structures and Incentives

As we discuss below in the operations profile of the Organics Cluster, the BPEO Assessment for Suffolk County and its districts concluded that Option 3, which is characterized by high levels of recycling and composting with “treatment” of the residual through anaerobic digestion, can reach 60% recycling and composting levels. The Waveney Solid Waste Management District may want to consider using some or all of the following strategies to achieve even more.

Pay as You Throw. Households pay for the amount of unrecycled resources thrown into the garbage collection system on a per-can or -bag basis. Recyclables are collected at no cost.

Mandatory Recycling. Requiring households, businesses, schools, and governmental agencies to participate in the recycling system is an effective educational and public awareness tool. It builds the foundation of an environmentally-literate citizen who costs local government and the broader environment less by wasting less. Mandatory recycling is complementary to a Pay-As-You-Throw system.

Productivity Bank. A productivity bank is a financial enterprise that provides low-cost capital to government agencies for environmentally sensitive projects. The agencies repay the loan using savings they achieve with the implemented system. For example, a city or county may calculate that new single-worker collection vehicles for recycling and composting would be cost-effective in the long run but not the short run. The productivity bank would lend the money for the agency to invest in the technology immediately, and the agency would repay the loan as it saves money on labor.

Start-up capital for a productivity bank could be available from the many recycling funding mechanisms available to county and local authorities.

Efficiency Utility. An efficiency utility serves the same purpose as a productivity bank, except it serves small businesses and households. For example, a loan to a business could capitalize a program that collects and composts discarded food from restaurants, hotels and institutional food services. Loans to households could support backyard composting bins and related tools. Both enterprises and households would repay loans through savings they accrue due to lower fees for collection, processing, and disposal.

Ecoindustrial Parks. These are industrial parks oriented around efficient resource management. They are reserved for production facilities that discard little or nothing, or that discard resources another company in the Park can use as a feedstock, or that use discards from inside or outside the Park as feedstock. Such facilities can take various forms and may be referred by many names, such as Ecoindustrial Estates, Recycling Market Development Zones, Zero Waste Centres, or Serial Materials Recovery Facilities. An added potential for an ecoindustrial Park might be community equity. Because the community would risk public money to develop the Park, provide economic incentives to the public to use it, and create other favorable financial provisions to incubate enterprises, the community might want to consider asking operators for equity in addition to rents. The Park operator and tenants could share equity in the forms of stock ownership; annual grants to the community based on a percent of profits; a host-community fee based on units of production; residents' first right of refusal for jobs; or community enterprises' first right of refusal on contracts for services such as catering, security, or worker recruitment and training. Many legal considerations would have to be explored, such as the ethical and legal complexities of public ownership in private enterprises, or putting a processing function out to tender if an enterprise partly owned by a public agency were underperforming, but the community might have some interest in considering new ideas.

Waveney has a number of enterprises and agencies that would be eligible to locate in an ecoindustrial Park. They include hardcore materials processors, scrap metals processors, composting facilities, and centres that refurbish furniture or recycle household resources.

Zero Waste Authority. A Zero Waste authority is a public entity that receives and disburses investment funds from a variety of sources. Funding options in Waveney could include a surcharge on all materials landfilled in the county; a bond offering; and special grants from sources in the UK and European Community. A new Waveney District Task Force could operate a Zero Waste authority that could be organized directly by local authorities, by an existing non-governmental organization such as Suffolk Connect, by a coalition of non-governmental organizations, or by some other combination of entities. Grants could cover training for administrators as well as provide capital for land acquisition and loans to or investments in manufacturing and processing companies. One successful model of a Zero Waste authority is StopWaste.Org, the Alameda County Source Reduction and Recycling Board, a county agency in California. The agency was created by a citizens' referendum and is financed by a surcharge on all materials landfilled in the county. StopWaste.Org provides low-interest loans and gives grants to cities and to for-profit and not-for-profit reuse, recycling, and composting enterprises. It does not, however, operate a ZW Centre such as the one proposed in this report.

In Waveney, an Urban Regeneration Company (URC) has been established for the subregion of Lowestoft and Greater Yarmouth. The URC has discussed the Zero Waste project and is interested in it. This URC has a target of creating more than 2,000 jobs over the next seven years, so it is particularly excited about the prospect of maximizing the number of jobs that could be created at this Zero Waste Centre. The local URC could administer a Waveney District Zero Waste authority, or if it expanded its horizons to cover all jurisdictions involved in the Zero Waste Centre, it could implement the project. Either arrangement would conform to plans for Suffolk County and East Anglia.

The UK central government is also interested in helping to fund local service providers including Community Strategies, Local Strategic Partnerships, and Local Area Agreements under the Modernising Government Act, the Sustainable Development Strategy, DTI and social enterprise procurement strategy, and other cultural support structures.

Other kinds of support are also promising. Initial discussions with the University of East Anglia have generated interest that can be taken further and will provide academic underpinning in the UK. Also, leaders of the WDC have expressed interest in developing standards related to recycling and use of recycled products.

Comprehensive Environmental Planning. All public, private, or community-sector facilities must satisfy permitting and operating regulations, and the Zero Waste Centre

will comply with all local codes and zoning. The Centre will have potential impacts that will need to be addressed early in its development. Issues to be analyzed will include:

- ◆ Land use
- ◆ Public utilities and services
- ◆ Geology and soils
- ◆ Hydrology and water quality
- ◆ Effluent treatment
- ◆ Biological resources
- ◆ Transportation
- ◆ Energy use
- ◆ Air quality
- ◆ Noise
- ◆ Health hazards
- ◆ Aesthetics
- ◆ Cultural and historic resources
- ◆ Chemicals
- ◆ Statutory nuisance
- ◆ Pollution prevention and control
- ◆ Protecting vegetation

It will be a major attraction for prospective tenants if the Centre's developers draft a Master Environmental Impact Report to anticipate the types of operations to be attracted. By preparing a comprehensive document, the developer and the community can identify issues to be addressed generally in planning and in detail later with specific tenants. Considering environmental issues early will expedite permitting for and acceptance of new tenants, because many or most of their operations' impacts will already have been mitigated or planned for before they agree to locate in the Centre.¹³

If environmental planning is done thoughtfully during the development stage, the very magnitude of the Centre can encourage residents to support it. Open, comprehensive planning will help calm any concerns about individual activities, and involving many groups can ensure that the process and work are of the highest quality, which will contribute credibility to the Centre, provide community education, and potentially generate excitement for the opening.

F. MARKETS, JOBS, AND REVENUES FOR REUSE, RECYCLING, AND COMPOSTING

The Zero Waste Centre returns materials to the economy that would otherwise be buried in a landfill. It also boosts participating businesses through the advantages of colocation. Being in the Centre will help enterprises achieve processing efficiencies, such as through shared equipment. These efficiencies can offset some difficulties the region's recycling businesses now experience as a result of being spread out, such as high marketing costs due to distances, and insufficient quantities of materials.

The Reuse and Repair Cluster may be able to process up to 6% of the total discard stream, or 6,000 tonnes a year. Economic benefits include new jobs and community wealth based on the newly augmented value of the reclaimed discards. The estimates

¹³ The Cabazon Band of Mission Indians near Palm Springs, California, prepared an example of that type of document for the development of their Resource Recovery Centre. For more details on their Resource Recovery Centre, see www.cabazonresourcerecoveryCentre.com/synergy.html.

below assume a 60% recovery rate and 100,000 tons per year of materials arising from this region, including Greater Yarmouth, Norwich, and Ipswich.

At full capacity, the Reuse and Repair Cluster of the Zero Waste Centre could generate: 50 new jobs; three new businesses or expansions of existing ones, to be determined; and more than £1.3 million in new revenue in the county annually. Enterprises would include reuse, electronics refurbishing, and textile reclamation. By nature they are labor-intensive enterprises.

The Recycling Cluster can process 43% of the total discard stream, so it has the potential to recover 43,000 tonnes per year, including miscellaneous metals that now end up at landfill.

At full capacity, the Recycling Cluster could generate 34 new jobs; four new businesses or expansions of existing ones; and add over £351,000 in new revenue in the county annually. The new businesses could include a paper packing plant, an animal bedding manufacturer, a plastics processor, and a manufacturer using a feedstock of discarded HDPE (high-density polyethylene plastic). Materials absorbed into existing businesses instead of new ones would still create new jobs due to the increased throughput.

Organics could be processed into methane gas to generate electricity or heat; other fuels; bulk mulch products; compost; or a range of products to be sold as soil conditioners at retail for households or wholesale for nurseries. Diverting organic materials from landfill would recover more than 37,000 tonnes a year, or 37% of the total discards.

At full capacity the Organics Cluster of the ZW Centre could generate 14 new jobs; three new businesses or expansions of existing ones; and more than £275,000 in new revenue in the county annually. The new businesses could include an anaerobic digestion facility or a biodiesel plant, and a pallet repair operation. Existing operations expanding into the Centre could include composting, mulching, and wood refurbishing. This labor and business estimate assumes that they share some labor and equipment.

Fully recovering the Clean DozenSM could save over £3.4 million annually by avoiding landfilling costs and could generate more than £2 million in sales revenues if all the materials were sold at current market prices. Table 7 shows estimated jobs and sales revenue. Alternatively, if about a quarter of the organics were digested to produce electricity and heat, they would yield the same revenues as if they were sold for their highest and best uses, about £200,000 per year. Because revenues are comparable, further financial analysis will assume the Centre uses the resources for energy products to provide additional energy-generating benefits from the project.

Table 7 - Estimated Jobs and Revenue from Sales of All Materials

Clean DozenSM Master Categories	Jobs	Tonnes per Year	Market Price £/T (est.)	Total Value of Discards in Waveney (£)
1. Reuse	40	6,000	£ 222	£ 1,340,986
2. Paper	5	20,000	£ 28	£ 560,000
3. Plant trimmings	2	12,000	£ 6	£ 72,000
4. Putrescibles	4	20,000	£ 11	£ 220,000
5. Wood	8	5,000	£ 6	£ 30,000
6. Ceramics	2	6,000	£ 8	£ 48,000
7. Soils	2	1,000	£ 8	£ 8,000
8. Metals	4	9,000	£ 28	£ 252,000
9. Glass	4	4,000	£ 11	£ 44,000
10. Polymers	21	10,000	£ 42	£ 420,000
11. Textiles	10	3,000	£ 11	£ 33,000
12. Chemicals	20	4,000	£ 11	£ 44,000
Total	122	100,000		£ 3,071,986
* 365 days per year. Based on 100,000 metric tonnes per year of available resources.				

G. OPPORTUNITIES FOR SOCIAL ENTERPRISE, TRAINING, AND EMPLOYMENT

Many kinds of businesses might want to start up at or relocate to the Zero Waste Centre to develop the resources flowing in daily. More enterprises are likely to spring up as the community gains experience with the facility and entrepreneurs watch the resources arrive. Some enterprises would do well at an ecoindustrial Centre. Many could be operated by Social Enterprises and would be eligible for national grants. The Centre can incubate businesses related to the Zero Waste purpose, including service enterprises. These are some kinds of enterprises that are well established or have been widely discussed in other regions, with the resources they would develop:

- ◆ Secondhand store(s) – furniture, cabinets, large and small appliances, electronics, textiles, toys, tools, plumbing fixtures, lighting, lumber, aggregates, windows, doors, and other used building materials. This enterprise could be affiliated with repair services or furniture and white goods refurbishers.
- ◆ Repair services – furniture, doors, windows, electronics, appliances, and lighting.
- ◆ Recycling processor – household and commercial commodities, including what is collected at kerbside.
- ◆ Biomass cogenerator – plant trimmings, putrescibles.
- ◆ Soil blender and bagger – soils, rocks, gypsum, other minerals, compost and mulches from onsite composter.

- ◆ Cafe and garden center – ZW Centre tenants' garden products.
- ◆ Confidential document destroyer – paper from contracted sources.
- ◆ Animal bedding maker – mixed paper, shredded and perhaps mixed with compost or mulch.
- ◆ Mini paper plant operator – mixed paper.
- ◆ Textiles recycler (rag trader) – textiles.
- ◆ Pallet rebuilder – lumber and pallets.
- ◆ Light manufacturer, plastics moulding – polymers.
- ◆ Composter – plant trimmings, food, food paper, other putrescibles, sheetrock, other minerals.
- ◆ Gravel and sand maker – rock, concrete, asphalt, brick, other ceramics that can be crushed for roadbed.
- ◆ Wood-fuel maker – untreated wood from yard trimmings and deconstruction.
- ◆ Chemicals redistributor, paint blending – reusable paints, household pesticides and cleaners from HHW collections.
- ◆ Cinder block maker – concrete and aggregates.
- ◆ Vermicomposter – putrescibles, plant trimmings.
- ◆ Furniture crafters – wood, pallets, perhaps metals.
- ◆ Textile artists, including clothing artisans – textiles.
- ◆ Light manufacturers, glassware and tile makers – glass, ceramics.
- ◆ Construction materials recycler – construction and deconstruction materials including wood, metals, sheetrock, ceramics.
- ◆ Biodiesel producer – spent grease and fats from restaurants and other industrial or agricultural sources.
- ◆ Deconstruction service provider – construction materials; deconstruction can be made mandatory for all takedowns. Small scale ethanol plant to use ag. waste from the surrounding region.
- ◆ Refurbishers – computers, large and small appliances.
- ◆ Facility managers – enterprise(s) to run the Zero Waste Centre and Bring centers.
- ◆ Recruiters and trainers – service enterprises to recruit employees and provide generalized safety and skills training for administrators, managers, and workers for any onsite operations that would like assistance. This service could be like a shared human resources and training department specialized in resource industries. Suffolk ACRE already provides some of these services.
- ◆ Business services – one useful service would be to advise businesses on eliminating waste in both their operations and products, and to devise appropriate end-of-life programs for products and packaging, such as voluntary takeback systems.
- ◆ Community services – enterprises to do outreach to the public, teach adults and school children about reuse, recycling, and back-yard composting, and to provide technical assistance to the public and distribute bins for backyard composting or recycling collection.

H. ZERO WASTE CENTRE CONCEPTUAL DESIGN

The Zero Waste Centre's physical infrastructure will mirror and implement the Waveney District's policy priorities of reducing, reusing, repairing, recycling, and composting before wasting. The design concept we recommend is a new facility featuring specialized niche operations to complement and expand public and private investments in the area, increasing the overall system's capacity to handle discarded materials without undermining current activities. Together the onsite enterprises will receive, process, and sell the full Clean DozenSM range of resources. The goal is to leave nothing for the landfill – Zero Waste.

1. Attraction for the Community

The design maximizes users' convenience by co-locating enterprises in a single efficient facility where the public can “drop and shop.” Users can bring all their discarded materials and also purchase products in the same place. The ZW Centre enables the community to:

- ◆ Decrease the quantity of materials tipped into the land.
- ◆ Decrease overall disposal expense by providing free or low-cost recovery for a growing market share of resources.
- ◆ Generate new income and employment opportunities in new or more favorably relocated locally-owned businesses.
- ◆ Provide a reliable source of interesting new products through both industrial manufacturing and arts and crafts.

2. Attraction for Participating Enterprises

All existing for-profit and not-for-profit businesses that reuse, recycle, compost, or manufacture products from recovered materials will be contacted to explore their interest in participating in this Centre. As we discussed in section G above, existing enterprises could either move their entire operations to the Centre; expand into the Centre by developing an additional facility; or provide trailers or storage boxes at the Centre so they can receive materials and transfer them to existing processing facilities.

Tenants can reduce expenses by sharing the site's services. They may be especially interested in the potential to market this large facility and its products as a single concept, as shopping malls do, to generate more awareness, interest, and traffic as a group than any operation could do individually. Also, when ZW Centre tenants naturally share expertise with each other, the sharing will enhance all their profitability.

The ZW Centre enables the participating businesses to share:

- ◆ Space, including warehousing and showrooms.
- ◆ Operating equipment such as forklifts, balers, shredders, wheel loaders, trucks, and weighbridges.
- ◆ Preventive maintenance and repair services.
- ◆ Pollution control equipment and services.
- ◆ Facilities such as maintenance yard, truck washing area, conference rooms, kitchens and break rooms, showers, and bathrooms.

- ◆ Managerial and technical expertise.
- ◆ Accounting, legal, and insurance services.
- ◆ Promotions and advertising costs.
- ◆ Governmental affairs and permitting services.
- ◆ Administrative and clerical support services.
- ◆ Communications equipment and services such as copiers, computers, internet access, websites, fax, radios, and phones.
- ◆ Staff recruitment and job training services.
- ◆ Restaurant or snack bar for ZW Centre businesses and customers.
- ◆ Educational facilities and services such as a nature trail, demonstrations of how to use recycled building products or compost products, onsite composting bins for residents and businesses, or an environmental education display or museum that could be an additional feature to attract residents and students.

The ZW Centre will also help participating businesses by matching producers' byproducts with others' needs for feedstocks. By becoming suppliers to each other, companies will reap these benefits:

- ◆ Decrease their disposal costs.
- ◆ Increase their cash flow.
- ◆ Build friendly networks in anticipation of beneficial trades to come.

3. Interactivity and Coevolution

The ZW Centre will group businesses in a workable, pleasing pattern and sequence for both suppliers and buyers, who will leave satisfied that they have not only done no harm, they have made a contribution. Its amenities will attract people to classes and workshops. Information will pass readily among businesses, which will enjoy new opportunities to learn from one another.

As the combined operation attracts more trade, new niches will grow. A business ecosystem will gradually emerge that feeds on resource flows from the larger economy, adjusts to surges and droughts, and dries up waste before it has a chance to happen. This industrial ecology will capture discarded resources before they are wasted.

Replacing the waste disposal system with a conserving disposal system will take several years to accomplish, but the community will enjoy some of the biggest benefits early, particularly with early involvement of reuse businesses and not-for-profit enterprises. The discard stream that will supply the Centre's businesses is the same one that is now buried, so the resource market shares will shift.

As the ZW Centre captures more, landfilling will decrease, permitted airspace will fill more slowly, and the landfills' lives will be extended significantly. The more materials are available, the larger the service niches become, and the more specialization will evolve. Those enterprises are also part of the larger recycling industry. This growing industry will comprise a collection of enterprises with an expanding repertoire of products, from one-of-a-kind eccentric crafts to mass-produced consumer goods that meet exacting specifications.

Because the ZW Centre will be organized around the recycling principle of highest and best use, it will turn out resources of high competitive quality and will attract buyers to the individual or bulk products. Most trade will be local and regional, but some products will be shipped to distant markets around the globe.

4. Tour of the Site Design

The Waveney ZW Centre will be conveniently located and is designed to handle approximately 300 tonnes of discarded materials per day. The proposed site plan is flexible and can be reconfigured as needs evolve. Local architectural and engineering services are required to take these ideas further. Customers who recycle the most will be able to reduce their overall disposal costs significantly. The site plan shows the Centre at full buildout.

a) Principles: Operating Clusters and Separated Traffic

As we discussed in the section on commodities, the Zero Waste Centre is organized around operating clusters: the Reuse and Repair Cluster; Recycling Cluster; Regulated Materials Cluster; Organics Cluster; C&D Cluster; and Industrial Centre. This section focuses on how the clusters function as the organizing principle of the physical plant's structure and the system's operations.

Also as discussed in the commodities section, the general public and multiple-axle vehicles enter using different roads. Since the roads serve different functions, they do not connect inside the site. After entering, the public bringing materials to the facility as suppliers are directed to the appropriate cluster based on the type of load they are carrying.

Since almost all public vehicles will be small, they will enter the site by traveling south on Pinbush Road. Employees and other site personnel will go to their workplace car parks – each reuse or recycling facility provides parking for its own employees as well as for customers and visitors. Suppliers will stop at unloading areas according to their load types and the materials they want to dispose of; and retail buyers go to retail store carparks. They can exit after the recycling area, or turn around at the roundabout and leave by Pinbush Road.

Inside the operating clusters, materials will generally move from the center, where they arrived, to the outer edges of the site as they are processed, upgraded, and then densified by being baled, stacked, or containerized.

Large multi-axle trucks, which occasionally may be suppliers but more often will be buyers, will enter from Tower Road and use the outer ring roadway for easy access to cleaned-up resource streams.

b) Resources Arriving – Suppliers' Traffic Path

After entering, small-vehicle suppliers with reusable items or large pieces of metal scrap will turn left immediately into the reuse receiving area, part of which is under roof.

Receiving staff will greet them, assess the load, and decide what to accept and what to pass on to recycling. Staff will also decide whether to offer to purchase anything and by what tender – cash or trade credit. After negotiations, staff will help unload whatever items have been accepted. Then the supplier will depart, turning either left if there is more to dispose of, or right to exit back onto Pinbush Road.

Suppliers with post-consumer recyclables continue on the inner ring past the reuse sales building and its parking lot, to pull into the first turnout on the left, the recycling dropoff and buyback area. More valuable materials such as aluminum or deposit containers may be unloaded at the buyback scale, which is accompanied by simple beneficiation equipment and a computerized cheque payment system. Just past the buyback, a dropoff area for no-cost recycling is lined with small bins, each with a sign showing which type of commodity it receives. Common commodities accepted at dropoff facilities are green, clear, and brown glass; steel cans; aluminum cans and foil; one or more types of plastic containers; cardboard; newsprint; mixed paper; books; textiles; and scrap metals.

At this point some suppliers have emptied their vehicles and can exit the site by turning left after the recycling center.

Suppliers still carrying materials continue around the inner ring's roundabout to a weighbridge and fee gate. The site's weighbridges are income portals. Enterprises in this section charge service fees to receive items or commodities whose sale prices alone cannot support all required processing, such as regulated items and materials that require special handling. Vehicles are weighed in at the entry and out at the exit; fees may be paid at either gate depending on the materials. If it is desirable not to staff both points, an electronic tracking system might be created in which, for example, users could be weighed in at an automated scale that dispenses an electronic tracking card, then at the exit weighed out and charged according to whatever information the operators have added to the card using networked information systems. Fees may be assessed by volume, weight, commodity type, or some combination of these factors. Individual locations or businesses within this area may also charge extra handling fees for specific materials.

These inner-ring scales might be considered optional if individual operators simply charge and collect their own fees. Eliminating the scales, however, would not provide as much information to help quantify achievement, and using the scales would let the facility collect a per-ton premium from suppliers who need the most expensive services.

Besides the regulated materials, bulk commodities received here include wood; plant trimmings; putrescibles such as food and food paper; soils; and ceramics such as concrete, tile, or stone. Materials requiring additional fees might be tyres; chemicals; mixed construction and deconstruction (to cover the cost of separating and sorting); appliances (to cover costs of dismantling and disposing of hazardous substances such as PCBs or mercury); or refrigerators (to cover the cost of degassing). In rare

instances, operators may also want to purchase incoming materials, usually things that have high reuse value.

The first unloading area is in front of a row of small buildings housing specialized businesses for materials that are regulated or require special handling. The list of such materials has been growing in the States and now includes paints and other chemicals; batteries; refrigerators and other appliances; tyres; motor oil; fluorescent lighting; and electronics. Operators handling these materials tend to be specialized, so the design provides a line of receiving bays. If desired, they can connect internally to sorting and processing areas. The processing is then connected to covered areas that permit accumulation and shipping so materials may be sent elsewhere for remanufacture or for further processing as industrial feedstocks.

Continuing along the fee road past the regulated materials enterprises, there is a large flat area where suppliers may unload clean plant trimmings, wood, and putrescibles, perhaps being charged fees tied to each material's processing costs and markets.

The last two tipping areas receive ceramics and soils, and mixed loads of construction or landscaping discards that require separation by hand or machine.

Most supply customers at this point have empty trucks and, after paying their fees, can leave the site as they came in by Pinbush Road. Those with unrecyclable residue, such as grossly contaminated plastics, will also leave the ZW Centre but can turn right off Hadenham Road into the existing waste transfer station, where they can consign their residue to the landfill. If the Centre operator decides to offer maximum convenience, a waste skip could be located before the fee is paid so customers could unload trash for the same fee as at the transfer station, or at a slightly higher rate to cover the costs of accumulation and transportation.

The exception to this traffic path for suppliers will be large trucks that collect recyclable materials generated by businesses. They will enter the facility by way of Tower Road and the New Access Road and will deliver their commercial loads of postconsumer or commercial recyclables to the commercial recycling facility at the northeast corner of the Centre. After delivering their loads, the trucks will leave by the New Access Road. This facility can be considered a Materials Recovery Facility. It will be equipped with sorting equipment including tables or a conveyor-fed picking line and a baler and could include a scale.

c) Resources Going Out – Buyers' Traffic Path

Three different streams of buyers will frequent the site and are accommodated in different ways depending on their vehicles. Those who arrive in cars and light trucks or on bicycles or motorbikes use the inner ring road. Those arriving in large commercial vehicles use the outer ring road.

One stream of buyers will be shoppers at the Reuse and Repair Cluster looking for furniture, building materials, hardware, art, electronics, clothing, antiques, and

collectibles. About 75 auto parking spaces provide ample space. Some of the customers are likely to be owners and operators of more specialized secondhand stores. Others will be householders, artists and artisans, real estate professionals, and tradespeople such as carpenters, landscapers, cabinetmakers, plumbers, decorators, tilesetters, and remodelers.

A second stream of customer traffic is from people interested in purchasing recycled-content products manufactured onsite or brought here to be sold. Enterprises in the Zero Waste Centre or Industrial Park can sell these consumer and construction products. One very popular product currently commanding high prices in US markets is a polished granite-like countertop made of recycled glass embedded in concrete. Other products might include: insulation made from recycled denim; floor tiles made from recycled glass or plastic; lumber made from plastic; compost mixes in bags or bulk; fuels made from fats or cellulosic materials such as straw; gravels and sands made from crushed concrete or asphalt. Repairing and remanufacturing businesses are growing rapidly in the US, and perhaps in England as well. By providing spaces for existing and startup businesses of this type, the ZW Centre can visibly link the resource supply to products that are remanufactured or manufactured with recycled content, creating efficiency for the businesses involved and making the connections obvious to the public. This will increase customer satisfaction, profits, and public understanding of the ZW Centre.

The third stream of buyer traffic is commercial vehicles that are large or have multiple axles – flatbed trucks, end-dump trucks, and tractor-trailer rigs picking up materials for export. They will enter the site from Tower Road and the New Access Road and use the outer ring road.

Both the reuse and recycling facilities will generate skips and sea containers of scrap materials, such as ferrous and nonferrous metals; unpainted wood; baled paper, textiles, and plastics; plate glass; and ceramics. Large trucks can pick up these bulk commodities at the north side of the recycling processing facility, entering from Tower Road and turning onto the New Access Road. To pick up other products, they will enter from Tower Road and then turn left onto the one-way outer ring road, where they pass over an entry weighbridge. They continue on to pick up products from the back of the Regulated Materials Cluster, and from the composting, crushing, and construction and deconstruction processors. They are weighed again before exiting onto Pinbush Road to ensure accurate financial transactions between the processors and their customers.

d) Zero Waste Centre Offices

In the middle of the Zero Waste Centre there are several office buildings equipped with meeting rooms that can be used for business support such as infrastructure management or training staff, or for public education. ZW Centre management and staff will occupy much of this space, but other organizations may also be recruited, such as Suffolk ACRE, Suffolk Connect, a time bank, and even a credit union. One or more food outlets might be able to operate profitably here as well. Demonstration gardens could use different products produced onsite. This area structures in an opportunity to

leaven the facility's potentially functionality with general community enrichment, symbiotic cultural development, amenities, and fun.

e) Operations in the Clusters

Because the cluster design allows materials recovery operations to be interactive and co-evolving, and because it structures in ways to earn income from both service fees and product sales, the participating enterprises can be expected incrementally and progressively to reduce both the amount and toxicity of the residual waste stream. With proper management, the residual waste stream may in time be nearly eliminated, allowing the Waveney District to come ever closer to achieving Zero Waste.

Over time, customers will learn to take full advantage of the system by stratifying their loads for sequential dropoff. Their behavioral sequence will be: eliminate waste at home or at their job site, then bring organized discards to the ZW Centre and be paid or drop off items cost-free for reuse; then be paid or drop off commodities cost-free for recycling; and finally pay a service fee for recycling regulated materials or for composting yard trimmings or putrescibles.

Whether the ZW Centre general operator and its niche enterprises pay for incoming materials or charge service fees will depend on internal expense and investment structures. That is, the biggest factor determining whether and how much the operator will pay users or charge them is how expected income compares to expected outlays. If a given object or material will sell for *exactly* enough money to cover operating expenses, capital costs, and necessary profit or surplus for reinvestment, then the operator can accept the item for free. If expected income is higher than expenses and other outlays, the operator can pay for the item or use the extra proceeds to cover less-profitable parts of the operation. If expected income is less than expenses, the operator must charge a service fee to make ends meet. Paying users even small amounts will change behavior faster than not paying. Over time, payments and fees will be adjusted frequently to maintain a dynamic balance in the enterprise and enhance prospects for long-term survival and growth, thus encouraging both maximum entrepreneurial zeal and maximum community participation. The decision structure looks like this:

<p style="text-align: center;">IF</p> <p>Income</p> <ul style="list-style-type: none"> - Operating expenses - Profit or investment surplus, including amortized capital costs <p>= Positive number</p>	<p style="text-align: center;">IF</p> <p>Income</p> <ul style="list-style-type: none"> - Operating expenses - Profit or investment surplus, including amortized capital costs <p>= 0</p>	<p style="text-align: center;">IF</p> <p>Income</p> <ul style="list-style-type: none"> - Operating expenses - Profit or investment surplus, including amortized capital costs <p>= Negative number</p>
<p style="text-align: center;">THEN</p> <p>PAY USER (maximizes change in behavior and good word-of-mouth community education) OR use surplus to support processing for less-profitable materials.</p>	<p style="text-align: center;">THEN</p> <p>ACCEPT FREE OR charge small user fee less than landfilling to support service for other less-profitable materials.</p>	<p style="text-align: center;">THEN</p> <p>CHARGE SERVICE FEE, less than landfilling.</p>

Using these internal financial cues to price handling and processing services will increase the likelihood of an enterprise's success while still providing the community the full benefits of avoiding landfill costs and pollution. In all cases the ZW operator should be able to charge users a lower service fee than transfer stations or landfills, which make no salable products and have to cover both long-term liabilities and short-term costs with service fees alone. The developer of the ZW Centre is the only entity that can leverage private investment by shifting avoided costs, so it is critical to get these service-price signals right.

(1) Reuse and Repair Cluster

The Reuse and Repair Cluster will provide an industrially zoned, state-of-the-art working environment for reuse, repair and dismantling enterprises, whether for-profit or not-for-profit. They will work in concert with the demands of current local and regional markets. The ZW Centre will include a state-of-the-art repair and dismantling facility working in concert with the changing demands of local and regional markets, possibly sharing equipment such as workshops or balers, or services such as marketing. One repair enterprise might be an electronic materials exchange that redistributes excess electronics to low-income individuals and charitable organizations. In the US there are such exchanges staffed by volunteers that refurbish internet-capable computers for low-income people domestically as well as Third World countries.

One feature of the Reuse Cluster is that businesses will pay for some incoming goods. Purchasing is a proven method of changing behavior. It rewards people for conserving whole objects, with their embodied energy and cultural and manufactured value, instead of simply saving the bulk commodity. Some tradespeople will become regular suppliers because they will change their practices from demolition to deconstruction either to realize the financial benefit or simply to do what they already believe is the right thing. An attitude survey conducted by Recycle Ann Arbor in the US State of Michigan showed that if remodeling contractors had a reuse facility available, they would remove materials such as cabinets intact rather than destroying them. A 1983 attitude survey in Berkeley, California, showed that self-haulers would have preferred to conserve rather than waste, but they needed a convenient facility. In the case of a reuse enterprise, if you build it, they really will come. When they do, they will bring resources that would otherwise have gone to waste.

Reusables will be purchased or dropped off at the reuse bays with the assistance of staff to screen the materials for reusability and salability. Processing for reuse primarily consists of hand sorting and cleaning. Reuse operators tend to prefer used equipment, although they may purchase new electronics to ring up sales. Boxes with mixed reusables will be sorted, cleaned, and priced on a belt or table. Doors are first stripped of protruding hardware, then are cleaned, priced, and racked up in the door sales gallery. Jewelry is untangled, cleaned, priced, and displayed in cases. Reusable goods can be sorted into scores of classes and types, each with a specific handling protocol. The more the materials are treated as conventional retail inventory, the better the enterprise will do. Reuse processing areas may be reconfigured periodically to increase

specialization as the business evolves. Minor repairs, cleaning and polishing, assembly, or disassembly will be done as needed.

Reusable goods also provide a strong source of some kinds of marketable scrap, either because the object is rejected for resale and is recycled, or because it is associated with reusable items but is most appropriately regarded as a commodity, or because reusable goods break, are dismantled by thoughtless customers, or become shopworn on the sales floor. Examples are cardboard from incoming boxes of mixed reusables, or aluminum from broken windows or doors, or copper from the wires of small appliances broken beyond repair. These scrap commodities may command high prices at area scrap yards, so the reuse operator will benefit from densification equipment such as a baler to help streamline operations at the intake and processing level. Scrap will be accumulated for transport to recycling and other downstream locations in the ZW Centre or beyond.

After reusable items are processed in the receiving department, they will be transported on carts out into the sales departments. Because the reuse operator distributes resources by way of retail sales, the distribution facility is equipped and maintained as a store using showrooms, display cases, racks, and other standard retail equipment. Household and office items must be kept indoors; some building materials may be displayed and sold in an outside yard if necessary. Sheds and portable racks with roofs can protect some building materials from wet weather. Some large loads of reusable items may be transported to other retail facilities elsewhere in the region.

(2) Recycling Cluster

The Recycling Cluster handles inorganic resources as commodities. The operations use a variety of bins, forklifts, loaders, scales, separators, picking lines, and balers to clean and densify materials destined for distant markets. A recycler's processing equipment may be particular to specific kinds of materials or common to several categories. Some businesses can achieve economies by sharing equipment.

Recyclables will be processed into high-quality feedstocks within a purpose-built warehouse whose wall will be a long row of collection bins. As small bins fill, they will be replaced with empties, and the full bins will be taken to processing areas either for simple aggregation or for additional upgrading. The operations may use picking lines, sorting tables, or both. Materials will be densified in a baler capable of producing export bales. Baled and containerized resources are stored for pickup at the end of the recycling building, and large trucks will pick them up and transport them to offsite markets.

At the next collection and processing section, specialized technicians will process large scrap metals, glass, tyres, and perhaps some related chemicals. These commodities may be brought by suppliers or by enterprises in other clusters. For example, the Regulated Materials Cluster might deliver refrigerators and freezers whose refrigerant has been removed, or the Construction and Deconstruction Cluster might bring large metal objects including fencing, staircases, or doors that are no longer reusable. To

maximize highest and best use, the scrap operator will screen materials and may sell or trade still-useful objects or parts, such as old stove parts, to the reuse operator. To add value by keeping commodities clean, staff will separate plate glass from aluminum, steel, and wood. Intact plate glass will be sent to the reuse area. Broken glass will be sent to the ceramics crusher to be made into sand. Tyres will be loaded into trailers for transport to tyre processing facilities. Aluminum and steel will be sold to metals brokers. Painted wood and vinyl must still be sent to landfill. Chlorofluorocarbons (Freon) will be sold to chemical companies. Lead-acid batteries will be stored for pickup in approved containers or may also go to the Regulated Materials Cluster, since enterprises' services may overlap.

Overlap in services will be beneficial to the public for dropoff convenience and not detrimental to the enterprises because service density has an attractive power. Shopping malls often contain stores whose clothing lines are similar or even the same, but the stores cluster together because customers are attracted to density of opportunity.

(3) Regulated Materials Cluster

Regulated materials will be collected according to material type in several bays after the weighbridge between the Recycling and Organics areas. This area will handle materials containing substances that are toxic or otherwise hazardous or potentially dangerous. Examples are: chemicals including antifreeze; batteries; oils and paints, which are all recyclable; refrigerators and air conditioners containing recyclable chlorofluorocarbons (Freon); tyres; cathode-ray tubes in TVs and computer monitors; electronic parts such as computer processors, keyboards, disk drives, printers, modems, and fax machines; brown goods – non-portable electronic goods that have substantial circuitry like microwaves, stereos, VCRs, DVD players, radios, audio-visual equipment, and LCD televisions; light bulbs, both fluorescent and incandescent; and other small consumer electronics including personal digital assistants, cell phones, phone systems, phone answering machines, computer games, other electronic toys, portable CD players, camcorders, and digital cameras. Again, in overlapping service, some of these electronics may be sent to the Reuse and Repair Complex for redistribution, while most are parted out for recycling.

Processing in the regulated materials businesses is complex in implementation but similar in sequence: gather the materials, separate components as appropriate, accumulate in safe containers, and when enough has been accumulated to warrant shipping, send to resource markets that may do further refining.

Oils and fats may be stored in drums. Batteries of various sizes and types are stored in special rectangular leakproof boxes before being marketed to processors. Televisions and computer monitors may be palletized. Electronics may be dismantled for parts, or whole objects may be palletized or stored in bins. Appliances may be parted out to recover handles, doors, switches, capacitors, and other parts, after which they can be placed in large bins for removal to the metals recycling area or to a scrap yard offsite.

Paints may be palletized for reuse, or remixed to produce a very low-cost coating, or processed for recycling or other disposal.

Paint will be classified into reusable, remixable, and unrecoverable. Reusable paint in good containers, with good labels, that make a sloshing sound when shaken will be sold at the reuse shop. Remixable paint will be combined and repackaged as generic low-cost coatings for applications such as graffiti removal or theater backdrops. Unrecoverable paint will be allowed to dry out to change its chemistry, then sent to landfill or metals reclaimers (this is current best practice in the US). Other chemicals may be reused (cleansers) or cleaned (motor oil, solvents), usually by offsite companies.

Regulations and rulemaking regarding these products is a work in progress, and local, regional, and national governments have adopted varying rules governing their reuse, recycling, and internment. Operators handling these materials will need to charge fees to cover the cost of collecting, sorting, storing, and transporting. In rare instances, operators may also want to purchase incoming materials, usually things that have high reuse value.

(4) Organics Cluster

The Organics Cluster will handle very large tonnages of organic materials primarily using bulk-handling procedures, although some labor-intensive methods will be used where appropriate. Equipment will include one or more movable shredders, one or more wheel loaders, and a variety of bins, tanks, and transport equipment.

Wood will be separated into reusable, recyclable, and landfillable categories. Reusable wood such as lumber or doors will be processed, such as by removing nails, and sent to the reuse business. Recyclable wood such as broken unpainted lumber will be ground up and aggregated for various end-users, including composters. Wood that is unrecyclable and uncompostable because it is painted or treated will be landfilled.

Plant trimmings will have limbs and trunks removed before shredding, and they will be split into firewood and either sold onsite or trucked elsewhere. After shredding, plant material can be sold raw as mulch, or transferred to windrows either onsite or offsite, either blended with putrescibles or not. Some could also be sent to the separate putrescibles area.

Putrescibles can be handled in various ways. They are valuable additions to compost, because composters control their products by balancing carbon and nitrogen. Plant trimmings with leaves, branches, and sticks, and wood, paper, and food-soiled paper have a high carbon content. Grasses and putrescibles are high in nitrogen.

Putrescibles from households can be received separately or mixed with plant trimmings. Waveney's recycling plan also calls for collecting organic materials together, including all yard trimmings and plant materials currently going in the green bins along with

discarded food and food-contaminated paper.¹⁴ From restaurants, markets, and the hospitality industry, they will be received separately and combined with plant trimmings during processing. Highly liquid batches that qualify as feedstocks for fuelmaking will be stored in enclosed tanks. Food and food-soiled paper may be mixed with plant trimmings prior to shredding, to obtain the proper balance of carbon and nitrogen.

Promising technologies are currently being developed to produce ethanol fuels from cellulosic residues, and biodiesel from plants and animal fats. One possible enterprise for the facility would be an in-vessel composter, or biodigestion system, that uses anaerobic (without oxygen) digestion in vessels to extract methane, a major component of natural gas and a greenhouse gas. This flammable gas could be used as a fuel for transportation, to heat buildings onsite, or to generate electricity for use onsite and for sale into the electrical grid. A separate report evaluating the feasibility of a biodigestion system for this area¹⁵ considered three options:

Option 1: Municipal and farm resources as feedstock. Animal manures, energy crops, and municipal organics would be collected, their energy extracted, and the residue returned to farms as biofertilizer, displacing mineral fertilisers and enhancing the quality of the soil.

Option 2: Municipal and green materials as feedstock. Food from retail stores, households, restaurants, and catering enterprises would be mixed with garden trimmings, with no farm residues.

Option 3: Municipal food as feedstock. Only putrescibles from retail stores, households, restaurants, and catering enterprises would be anaerobically digested.

Although Option 1 has the most benefits environmentally, Option 2 was found to be the most cost-effective scenario because none of the 6,800 tonnes of animal residues in Option 1 is assumed to pay a gate fee.¹⁶ Implementing Option 1 would also take more effort. As a result, it is assumed that the Option 2 scenario will be implemented in the first phase of the ZW Centre.

Onsite windrow composting will be designed principally to process self-hauled yard trimmings and to cure byproducts from the biodigestion facility. The windrows' products will be used alone to improve soils or in blends for growing media and topsoils. These products would then be quantified to assess progress in recycling and as diversion of biodegradable resources from landfill. Alternatively, biodigestion systems could be placed at other locations in the region. If processing is done offsite, the ZW Centre could host bins to collect discarded food and food-contaminated paper for regular transport to the offsite biodigestion facilities.

Existing private composters in the area might want to expand their operations, and the ZW Centre could provide them the land. Alternatively, an in-vessel composter located

¹⁴ *Recycling Plan for the Waveney Area in the Municipal Waste Management Strategy for Suffolk – Adopted Version.*

¹⁵ Rutherford Collins Ltd, *Suffolk Connect Resource Recovery Centre Options for Biodigestion*, Draft Report, September 2005.

¹⁶ *Ibid*, page 6-22.

somewhere else could receive discarded food and send digestion's residues to the windrows for curing. Then in-vessel systems could be built in much smaller locations, even placed onsite at large generators. Haulers in the area might consider financing and managing onsite composters as they lease and manage onsite cardboard compactors. The ZW Centre could encourage that type of collection system to evolve.

(5) Construction and Deconstruction Cluster

At the end of the ZW Centre, the Construction and Deconstruction (C&D) Cluster will receive loads of C&D materials, landscape materials, soils, and ceramics. Loads will be dumped onto a concrete or asphalt pad, where experienced salvagers will separate them into reusable, recyclable, and compostable components. They will use a variety of bins, one or more loaders, and transport equipment to move the separated materials to appropriate processing areas within the site. Processing areas will use crushers, screens, stackers, and loaders.

Reusable materials will be delivered to the Reuse and Repair Cluster for onsite processing and sale. Recyclable commodities will be loaded into skips to go to the onsite commercial Materials Recovery Facility, where they will be sorted into different commodity streams. Other untreated wood and organics will be delivered to the onsite shredding operation in the Organics Cluster. Ceramic materials such as stone, asphalt, tile, or concrete will be crushed and screened into gravels and sands using machinery adapted from quarrying. Soils will be aggregated for transport to the composting area, where they will be mixed with compost to produce the heavier, more mineralized topsoils that meet PAS 100 standards. Soils can be screened to remove unsightly or off-spec inclusions such as rocks or bits of lumber, but any soils containing hazardous material will be sent to appropriate facilities for treatment or landfilling.

The tipping fee for this C&D Cluster may need to be higher than that for separated organics or soils and ceramics, but it will still be lower than fees at the Waste Transfer Station.

(6) Ecoindustrial Park

Three areas are set aside as an Ecoindustrial Park providing buildings for remanufacturing, repair, business incubation, and related sales. Over time, businesses that start at the ZW Centre and become successful enough to grow may want to move offsite into other parts of the Waveney region. This will make space available to new entrants to the field.

If the ZW Centre obtains the full 30 acres proposed, then it would have sufficient space to attract manufacturers of recycled-content products. The benefits of a project like this are described below in Table 8 using sample kinds of industries.

Table 8 – Sample Products and Benefits of a Recycling-Based Ecoindustrial Park¹⁷

Company or Product	Acres	# Jobs	£ Investment (est.)
Recycled/crumb rubber	7	115-150	£ 6,657,000
Building materials/insulation	2	35	£ 277,375
Computer/hardware	1	20- 40	£ 55,475
Computer/software	1	20- 40	£ 55,475
Green roofing material	2	35	£ 138,688
Plastic products from recycled HDPE	1	25	£ 554,750
Deconstruction services and resale outlet	3	35- 50	£ 55,475

(7) Related Activities – HWRC and Transfer Station

Next to the ZW Centre are two related facilities, the newly relocated WDC Household Waste and Recycling Centre (HWRC) and the local solid waste Transfer Station. The functions of the HWRC overlap with recycling in the Zero Waste Centre, but residents will benefit from locating the ZW Centre next to the HWRC because they can choose to visit either facility, and they can drop off both their recyclables and reusables in the same trip. The system hasn't provided this one-stop feature since the HWRCs stopped accepting reusables because of space limitations. Residents will become accustomed to "dropping and shopping," and while they're at the ZW Centre, browsing in the reusables and bringing home a load of firewood, compost, or other recycled products for sale.

ZW Centre users will also be able to use the system's one-stop feature to include in their loads any materials that cannot currently be reused, recycled, or composted, which they can take to the adjacent Transfer Station. The Transfer Station operator may wish to partner in developing the ZW Centre, to diversify its interests and protect itself from the loss of business that will inevitably occur once the ZW Centre is opened. The Transfer Station may also want to redesign its receiving floor to salvage more reusable and recyclable products it receives before pushing resources into the waste transfer trailers. The Transfer Station operator could pay for trained salvagers provided by ZW Centre tenants to accomplish this salvaging work, particularly if paying for salvaging and delivering recovered resources to the ZW Centre costs less than delivering wastes to landfill. The Transfer Station operator may also benefit from extending the life of its private landfill. As the costs of landfiling and permitting new landfills increase over time, that space will be increasingly valuable. If rates are properly structured, the existing fill may provide the landfill operator with comparable returns on investment

¹⁷ This is a sample industrial Centre footprint from the Institute for Local Self-Reliance's work with a community group that is planning for a 17-20 acre site in a south Chicago brownfield area. This profile assumes that all land and buildings will be rented, but recognizes that some companies will want to purchase their facilities.

even as tonnages decrease. The Transfer Station operator may also wish to provide discounted rates to users of the ZW Centre to dispose of their materials at the Transfer Station after going to the ZW Centre. Those discounts could be funded by an increase in rates for other users of the Transfer Station.

I. FINANCIAL ANALYSIS: REVENUES, COSTS, AND OTHER BENEFITS OF A ZERO WASTE CENTRE

The actual financial structures of a completed Zero Waste Centre will depend on particular information from enterprises that are currently unidentified. Still, a general profile can be painted of the revenues and costs expected from developing the Waveney ZW Centre. The analysis is based on 100 tonnes per day input of materials from the Waveney District.

The analysis is divided into the key major components: reuse, recycling, regulated materials, organics, and C&D materials. An analysis of the additional 15-acre industrial Park potential was beyond the scope of this project.

Either public or private operators could run the different processing facilities. There are both for-profit and not-for-profit organizations and businesses in the area that might want to expand their operations but need land to do so, and the ZW Centre might provide them with an opportunity.

The total capital costs for the ZW Centre, not including land purchase, are estimated to be about £7.1 million as shown in Table 9.

Table 9: Summary of Capital Costs to Implement the ZW Centre

Cluster	Buildings and Paving	Equipment and Fixtures	Total Costs
Reuse	£ 610,225	£ 87,373	£ 697,598
Recycling	£ 776,650	£ 428,766	£ 1,205,416
Regulated Materials	£ 665,700	£ 389,102	£ 1,054,802
Organics	£ 2,633,427	£ 357,164	£ 2,990,591
C&D Materials	£ 844,884	£ 341,171	£ 1,186,055
Total	£ 5,530,886	£ 1,603,576	£ 7,134,462

The annual operating and maintenance costs for the ZW Centre (including amortized capital costs) are estimated to be about £1.6 million per year, as shown in Table 10.

**Table 10 - Annual Operating and Maintenance Costs
for the Zero Waste Centre**

Reuse	£	510,160
Recycling	£	249,558
Regulated Materials	£	209,616
Organics	£	380,723
C&D Materials	£	218,575
Total annual O&M costs	£	1,568,632

Table 11 shows that expected benefits are about £141 on each tonne for the Reuse and Repair Cluster; £31 per tonne in the Recycling Cluster; £41 per tonne in the Regulated Materials Cluster; about £56 per tonne in the Organics area; and about £51 per tonne in the C&D Cluster. Each case includes £49 savings in landfilling costs. These results underscore the importance of factoring in the avoided wasting costs into the economics of different clusters to evaluate properly the economics of the ZW Centre's different components. The Centre's overall benefit is £52 per tonne, adding up to more than £3.4 million savings in money alone from avoiding landfilling. This figure doesn't quantify the environmental and cultural advantages of preventing pollution. This result underscores the importance of evaluating the overall resource system, not just its individual components.

Table 11 – Benefits and Cost of the Zero Waste Centre by Cluster*

Cluster	Capital (per year)**	O&M (per year)	Annual Costs	Landfilling Savings***	Sales (per year)	Gate Fees (per year)	Tonnes (per year)	Benefits/ (Costs) per Tonne
Reuse	£ 30,511	£ 479,649	£ 510,160	£ 439,362	£ 1,340,986	£ 2,630	9,000	£ 141
Recycling	£ 38,833	£ 210,725	£ 249,558	£ 657,969	£ 351,673	£ 552,598	43,000	£ 31
Regulated Materials	£ 33,285	£ 176,331	£ 209,616	£ 195,272	£ 14,500	£ 164,000	4,000	£ 41
Organics	£ 131,671	£ 249,052	£ 380,723	£1,806,266	£ 275,911	£ 352,626	37,000	£ 56
C&D	£ 42,244	£ 176,331	£ 218,575	£ 341,726	£ 94,308	£ 140,000	7,000	£ 51
Total	£ 276,544	£1,292,088	£ 1,568,632	£ 3,440,595	£ 2,077,378	£ 1,211,854	100,000	£ 52

* Note: These figures do not include the impacts of expected economic multipliers.

** Amortization: 20 years for buildings and paving, 6 years for equipment and fixtures.

*** £49 per tonne savings by avoiding landfilling costs.

J. CONCLUSION

This analysis finds resources in Waveney of sufficient quantities and values to support a Zero Waste Centre. Existing and potential enterprises, both for-profit and not-for-profit,

can be configured over time to occupy the Centre in a design that will provide convenient and pleasant resource handling for the community. Economic multipliers will add to the high benefit already expected. After considering competitive alternatives and profiling individual components of the proposed system, Richard Anthony Associates have concluded that the ZW Centre is feasible and is highly promising as a way to prevent and reduce waste and to develop community wealth.

III. APPENDIX A – ESTIMATED REVENUES AND COSTS

The following Excel spreadsheets are the detailed estimates for each operating cluster.